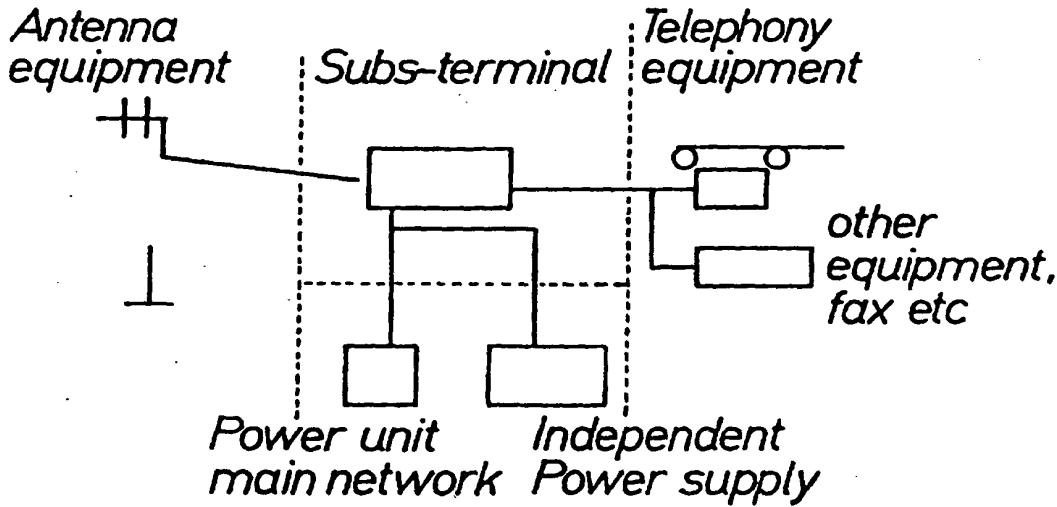




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(72) Inventors; and			Published	
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(74) Agents: HOLMQVIST, Lars, J., H. et al.; Albinh Holmqvist AB, P.O. Box 4289, S-203 14 Malmö (SE).				

## (54) Title: SUBSCRIBER TERMINAL ARRANGEMENT



## (57) Abstract

The invention relates to a subscriber terminal arrangement in a telecommunication system utilizing radio in the local loop. According to the invention, the arrangement comprises a subscriber terminal comprising a low power radio part, a pulse code modulation air interface and a low power paging channel for the call set-up procedure, a power supply part, and a user terminal comprising a hand-set and a dialling device. Ordinary telephone equipment, telephone fax, answering machine, data modem, PCs etc, may be connected to the subscriber terminal. In some cases the radio parts and telephony parts would be integrated in the same unit. The power supply part may be connected to an independent power supply unit comprising a power generator, e.g. solar panels and/or a wind generator, rechargeable batteries, and a control unit for controlling the charging procedure. The air interface is capable of supporting 64 kb/s PCM coding offering high quality audio, and/or variable data rates up to 64 kb/s.

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## TITLE OF INVENTION: SUBSCRIBER TERMINAL ARRANGEMENT

10

FIELD OF THE INVENTION

The present invention relates to a subscriber terminal arrangement in a telecommunication system utilizing radio in the local loop. Radio in the Local Loop (RLL) is, substituting the copper lines in the local loop, the part of the network which is between the local exchange and the subscriber at home, with radio. The market for these applications is enormous, especially in the new growing economies like Far East, Russia and Brazil. Another growing market is the industrial countries where radio is the best solution for a new operator to compete with services in the local loop. Fixed subscriber terminals mean terminals which are not designed for mobility purpose. The terminal is placed in the home, office etc. and can be moved in the premises but not like hand held portable telephone. Ordinary telephone equipment, telephone fax, answering machine, data modem, PCs etc, could be connected to the terminal. In some cases the radio parts and telephony parts would be integrated in the same unit.

30

STATE OF THE ART

Today there are two main categories of radio subscriber terminals; for mobile use and fixed telephones connected to ordinary fixed network for telephony (POTS, Plain Ordinary Telephony System).

Today's radio subscriber terminals are power-consuming, expensive (due to standardized POTS interface), bad audio quality, no variable data rates etc. When the receiver is lifted there is a long delay before the dial tone is given. When mobile telephones are used, the subscriber have to

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## TITLE OF INVENTION: SUBSCRIBER TERMINAL ARRANGEMENT

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The present invention relates to a subscriber terminal arrangement in a telecommunication system utilizing radio in the local loop. Radio in the Local Loop (RLL) is, substituting the copper lines in the local loop, the part of the network which is between the local exchange and the subscriber at home, with radio. The market for these applications is enormous, especially in the new growing economies like Far East, Russia and Brazil. Another growing market is the industrial countries where radio is the best solution for a new operator to compete with services in the local loop. Fixed subscriber terminals mean terminals which are not designed for mobility purpose. The terminal is placed in the home, office etc. and can be moved in the premises but not like hand held portable telephone. Ordinary telephone equipment, telephone fax, answering machine, data modem, PCs etc, could be connected to the terminal. In some cases the radio parts and telephony parts would be integrated in the same unit.

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Today there are two main categories of radio subscriber terminals; for mobile use and fixed telephones connected to ordinary fixed network for telephony (POTS, Plain Ordinary Telephony System).

Today's radio subscriber terminals are power-consuming, expensive (due to standardized POTS interface), bad audio quality, no variable data rates etc. When the receiver is lifted there is a long delay before the dial tone is given. When mobile telephones are used, the subscriber have to

- enter the number and thereafter have access to the radio channel (the send button is pressed).

The present invention solves the above-mentioned problem by providing an improved subscriber terminal arrangement.

5 The unique features of the subscriber terminals are based on:

- 64 kb/s PCM coding, (Pulse Code Modulation) which can offer:

10 + high quality audio 7, 2 kHz bandwidth compared with today's 3,1 kHz bandwidth for today's POTS (Plain Ordinary Telephony System)

+ by multiplexing several (3-4) PCM channels, high quality hi-fi audio is offered

15 + variable data bit rates up to 64 kb/s

+ multiplexing of PCM channels to offer ISDN BRA, Integrated Services Digital Network, Basic Rate Access

- a simplified version of POTS network and protocols

20 - multi-user terminals with internal switch functionality in order to reduce the capacity requirement on the network.

25 - an independent power supply unit where there is no need of external power supply

- low power paging channel giving:

+ low power consumption

+ no delay for giving dial tone when receiver is lifted

30 - an integrated radio head in the antenna

#### SUMMARY OF THE INVENTION

Thus, the present invention provides a subscriber terminal arrangement in a telecommunication system utilizing radio in the local loop.

According to the invention, the arrangement comprises a subscriber terminal comprising a low power radio part, a pulse code modulation air interface and a low power paging channel for the call set-up procedure, a power supply part,

and a user-terminal comprising a hand-set and a dialling device.

The invention is set forth in detail in the accompanying claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described below with reference to the attached drawings, in which

Figure 1 is a block diagram of a first embodiment of the invention for ordinary POTS;

Figure 2 is a block diagram of a second embodiment of the invention in which the subscriber terminal equipment and the telephony equipment are integrated in the same physical unit;

Figure 3 is a block diagram of a third embodiment of the invention, in which the radio part and the power supply unit are integrated in the same unit;

Figure 4 is a block diagram of a fourth embodiment of the invention including a multi-subscriber terminal; and

Figure 5 is a block diagram of a further embodiment of the invention in which the RF part is integrated with the antenna.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

25 There are two main groups of digital radio fixed subscriber terminals:

- the single user terminal family,
- a multi-user terminal family

All the terminals are based on low power radio with 0,1 W output. Both families could either be connected to an ordinary power supply unit, utilising the mains power supply, or an independent power supply unit. This unit is utilising solar/wind energy and rechargeable batteries. All terminals are utilising a low power paging channel for implementing the alert function. This sleep mode function results in very low power consumption between calls. Therefore, the terminals could be used with powering from only solar/wind energy and batteries. The paging channel will be used in the call set up procedure i.e. the dialled number will transferred immediately to the network at the same time as the radio

speech channels is allocated. This will result in no delay when the receiver is lifted and an immediate dial tone is given.

The paging function is similar to the POGSAG defacto standard which is capable to transfer 512 baud. For easy customer installation, the terminals are equipped with a LED indicator, showing red (no radio reception), yellow (not enough reception) and green (good radio reception).

In Figure 2, an embodiment of the single subscriber terminal family is shown.

As may be seen from Figure 1, the copper lines of an ordinary telephone network is replaced by an antenna equipment. The antenna equipment is connected to a subscriber terminal (Subs-terminal) which in turn is connected to the telephony equipment. The subscriber terminal includes the radio.

The terminal family is based on a digital radio with 0,1 W output. The service is based on 64 kb/s PCM coded radio channels. The telephony equipment at least consists of a hand-set and a dialling device, such as a key pad.

The following services would be offered:

- Ordinary POTS, including DTMF signalling (Dual Tone Multifrequency) and fax machine or similar.
- Data over modem; 9,6, 14,4, 28,8 up to 64 kbit/s
- Dedicated data up to 64 kb/s

The ordinary telephone equipment is connected to a line interface (CCITT recommendation) which would be able to support an ordinary ringing generator and 2000 meter 2 wire copper cable i.e. 2/4 wire ordinary line interface.

There are three different versions of antenna installations:

- an antenna connected directly to the user terminal (omnidirectional, radiation in all directions)
- a separate antenna which could be placed in the window (omni/directional, radiation in a specific direction)
- an outdoor roof or wall/roof mounted antenna (directional)

There is an antenna connector at the subscriber terminal for connection of different types of antenna alternatives.

The present invention also provides a simplified sub-

scriber terminal; "Proprietary POTS". There are three different versions:

Version 1

5 The main difference is the subscriber telephone equipment. One possibility is a telephony equipment, which is specially adapted to the subscriber terminal, without ringing generator and no lightning protection i. e. no standard POTS interface. The ringing signal is generated by 10 a piezoelectric ringer in the hand-set. This would lead to a less complex implementation and therefore a reduction in cost because there is no standard line interface circuitry. The distance between the radio subscriber terminal and proprietary telephone equipment is maximum 50 meters. The power 15 supply is 2 W DC. This solution would need a proprietary telephone equipment.

The same services as above is offered.

Version 2 is currently planned and will be:

20 Another version is where the subscriber terminal equipment and the telephony equipment are integrated in the same physical unit. In order to save cost through simplicity there is no external line interface at all. The implementation is shown in Figure 2.

25

Version 3

There is one version where the radio part and power equipment are integrated in the same unit. This unit should be plugged directly into the wall. There are three input/output connections for: external antenna connection, a 30 connection for the telephone equipment and one for DC input (battery backup or in case of no main supply) see Figure 3.

There are two different versions of antenna installations:

35 - a separate antenna which could be placed in the window (omni/directional, radiation in a specific direction)  
- an outdoor roof or wall/roof mounted antenna (directional)

There is an antenna connector at the radio terminal for 40 connection of different antenna alternatives.

One embodiment of the invention features a radio terminal which would provide ISDN Basic Rate Access, BRA. As an alternative the terminal can offer two ordinary POTS lines in accordance with the first embodiment.

5       Similarly, there are three different versions of an-  
      tennas.

The invention provides a multi-subscriber family suitable for apartment buildings or offices, where it is desired to connect several user terminals.

10 This terminal family is also based on low power radio with 0,1 W output. The service is based on 64 kb/s PCM coded radio channel. There will be three different sizes serving up to 4, 8, 16 and 16-32 subscribers. All versions would provide the following services:

15 - Ordinary POTS  
- Data over modem; 9,6, 14,4 28,8 up to 64 kbit/s  
- Dedicated data up to 64 kb/s  
- One version combining ISDN and POTS.

20 The later could in a flexible way be tailored for 16-32  
subscribers. Depending on the number of subscribers there  
are 16-32 64 kb/s PCM radio channels which will basically  
serve up to 32 subscribers. There would even be a version  
which would be utilising concentration i. e. there are fewer  
25 radio channel connections than the number of subscribers  
connected to the terminal. For example 30 PCM channels can  
support 290 customers (Traffic requirements: 70 mE/customer,  
0,01 % blocking).

The principles of the multi-subscriber terminal family  
30 is shown in Figure 4:

In order to not be independent of mains power supply (from the electricity company) there should be an option where the user terminals are connected to an independent power supply unit. The unit consists of:

35

- Power generator; solar panels or/and wind generator
- rechargeable batteries
- control unit, controlling the charging procedure

40 There would be one terminal version where the radio

frequency parts (RF parts) are moved from the subscriber terminal unit and are integrated together with the antenna. The radio parts in the RF unit are DC powered (Direct Current) by the subscriber terminal via the antenna cable.

5 Thus, the present invention provides an improved subscriber terminal arrangement having the advantages stated above. Of course, many variations and modifications as well as combinations of the disclosed embodiments will be recognized by a person skilled in the art. The invention is only 10 restricted by the claims below.

11. The subscriber terminal arrangement of claim 10, wherein the antenna is connected to the subscriber terminal unit via a cable which is terminated at one end in a connector and at the other end in a plug which is connected to the subscriber terminal unit.

12. The subscriber terminal arrangement of claim 10, wherein the antenna is connected to the subscriber terminal unit via a cable which is terminated at one end in a connector and at the other end in a plug which is connected to the subscriber terminal unit.

13. The subscriber terminal arrangement of claim 10, wherein the antenna is connected to the subscriber terminal unit via a cable which is terminated at one end in a connector and at the other end in a plug which is connected to the subscriber terminal unit.

14. The subscriber terminal arrangement of claim 10, wherein the antenna is connected to the subscriber terminal unit via a cable which is terminated at one end in a connector and at the other end in a plug which is connected to the subscriber terminal unit.

15. The subscriber terminal arrangement of claim 10, wherein the antenna is connected to the subscriber terminal unit via a cable which is terminated at one end in a connector and at the other end in a plug which is connected to the subscriber terminal unit.

16. The subscriber terminal arrangement of claim 10, wherein the antenna is connected to the subscriber terminal unit via a cable which is terminated at one end in a connector and at the other end in a plug which is connected to the subscriber terminal unit.

## CLAIMS

1. A subscriber terminal arrangement in a telecommunication system utilizing radio in the local loop, **characterised** by a subscriber terminal comprising a low power radio part, a pulse code modulation (PCM) air interface, and a low power paging channel for the call set-up procedure, a power supply part, and a user terminal comprising a hand-set and a dialling device.
2. An arrangement according to claim 1, **characterised** by a standard (e.g. CCITT) line interface between the subscriber terminal and the user terminal, the interface supporting a ringing generator and a two wire copper cable.
3. An arrangement according to claim 1, **characterised** by a simple two wire connection between the subscriber terminal and the user terminal, the user terminal further including a piezoelectric ringer.
4. An arrangement according to claim 1, **characterised** in that the subscriber terminal and the user terminal are integrated in the same unit.
5. An arrangement according to any one of the preceding claims, **characterised** in that the power supply part is integrated in the subscriber terminal.
6. An arrangement according to claim 1, **characterised** in that the subscriber terminal includes an interface for connecting a number of user terminals, e.g. up to 4, 8, 16, 32 or more.
7. An arrangement according to any one of the preceding claims, **characterised** by concentration in the radio part for supporting a greater number of user terminals than the number of radio channels.
8. An arrangement according to any one of claims 1 to 5, **characterised** in that an omnidirectional antenna is connected directly to the user terminal.
9. An arrangement according to any one of claims 1 to 7, **characterised** in that a separate antenna is connected to the subscriber terminal, e.g. directly on the subscriber terminal or via lines to a window, wall or roof mounted antenna.
10. An arrangement according to any one of the preceding claims, **characterised** in that the power supply

part is connected to an independent power supply unit comprising a power generator, e.g. solar panels and/or a wind generator, rechargeable batteries, and a control unit for controlling the charging procedure.

5 11. An arrangement according to any one of the preceding claims, characterised in that the air interface is capable of supporting 64 kb/s PCM coding offering high quality audio, and/or variable data rates up to 64 kb/s.

12. An arrangement according to claim 11, characterised  
10 in that that the air interface is capable of multiplexing  
several PCM channels offering hi-fi audio, or ISDN basic  
rate access (BRA).

13. An arrangement according to any one of claims 1-3, 5-7, and 9-12, characterised in that the RF unit of the 15 radio part is integrated with an antenna, the RF unit being powered from the subscriber terminal by an antenna cable.

1/2

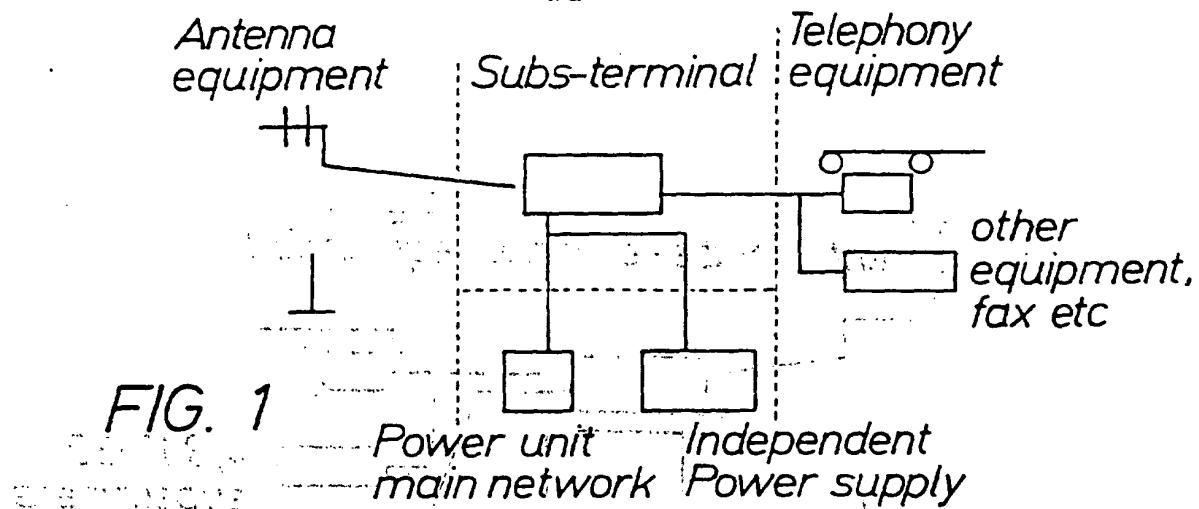


FIG. 1

Detailed description

Antenna equipment

Integrated Subs-terminal

Power unit

Independent main network power supply

FIG. 2

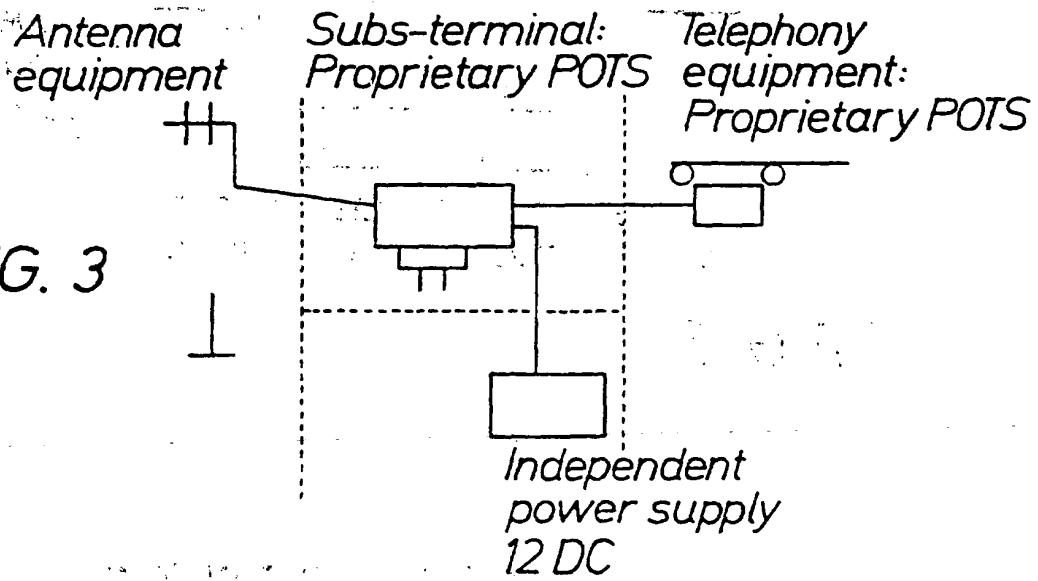


FIG. 3

SUBSTITUTE SHEET

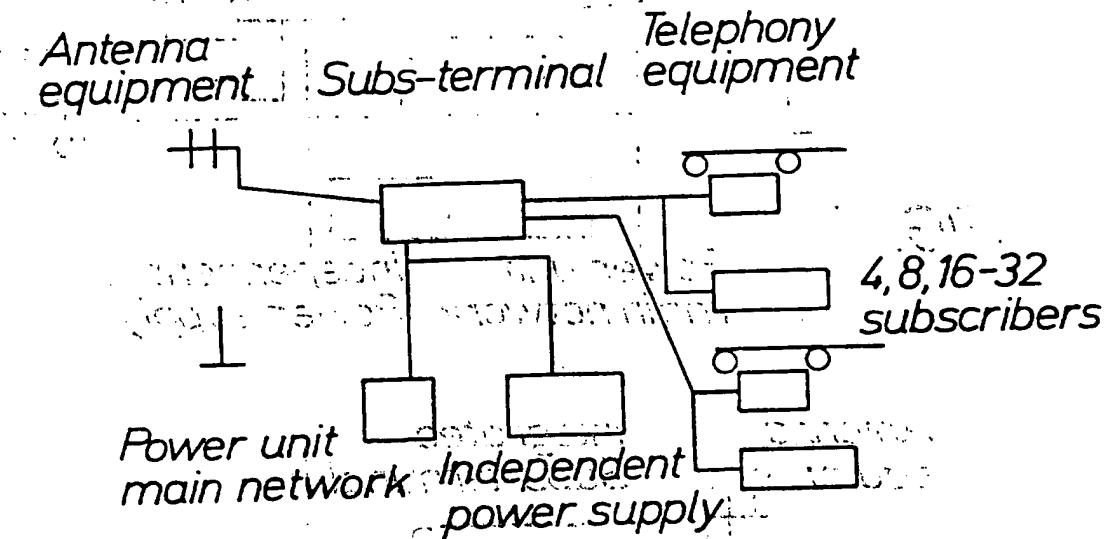


FIG. 4

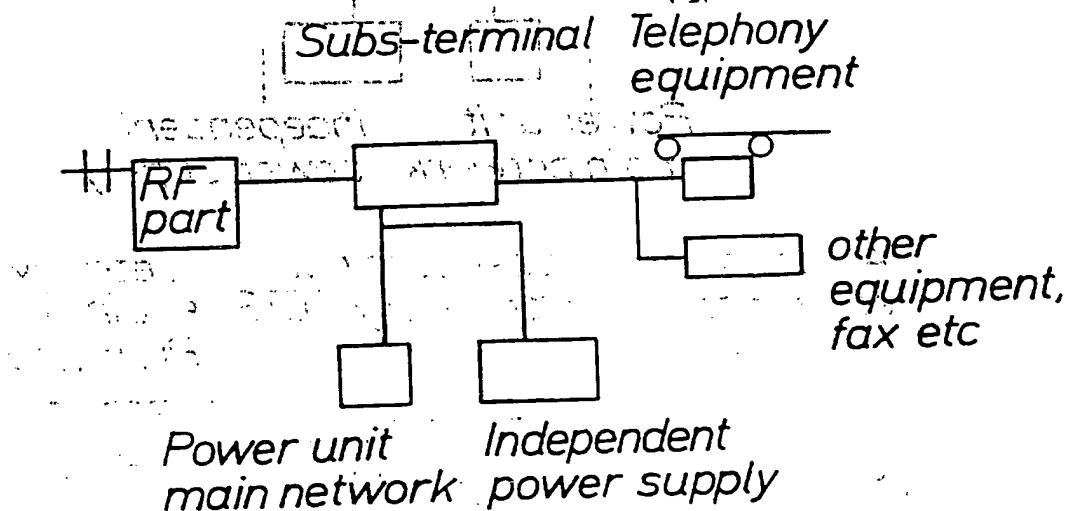


FIG. 5

**SUBSTITUTE SHEET**

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/00503

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/24

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0583233 A2 (HUGHES AIRCRAFT COMPANY), 16 February 1994 (16.02.94), column 6, line 4 - line 22; column 17, line 5 - line 12, abstract --	1-9,10
Y	GB 2230162 A (MITSUBISHI DENKI KABUSHIKI KAISHA), 10 October 1990 (10.10.90), page 5, line 18 - page 7, line 2 --	1-9,10
Y	US 5444867 A (KUNIYOSHI MARUI ET AL), 22 August 1995 (22.08.95), column 1, line 39 - line 54; column 2, line 16 - line 28 --	10

 Further documents are listed in the continuation of Box C. Sec patent family annex.

- \* Special categories of cited documents:
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- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

9 July 1997

Date of mailing of the international search report

12 -07- 1997

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/00503

## C (Continuation). DOCUMENTS-CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9419877 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 1 Sept 1994 (01.09.94), page 7, line 13 - page 8, line 19; page 10, line 18 - line 29	1-6, 8, 9

**INTERNATIONAL SEARCH REPORT**International application No.  
PCT/ISA/210 (continuation of first sheet (1)) (July 1992)  
PCT/SE 97/00503**Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
2.  Claims Nos.: 7, 11-13 because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:  
Neither the description, nor the claims comprise any characteristic details on how the arrangements mentioned in claims 7, 11, 12 and 13 are supposed to be realized.
3.  Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remarks on Protest**

The additional search fees were accompanied by the applicant's protest.  
 No protest accompanied the payment of additional search fees.

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

01/07/97

International application No.

PCT/SE 97/00503

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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WO 9419877 A1	01/09/94	AU 5825294 A CA 2133735 A CN 1108450 A EP 0636290 A EP 0647302 A FI 944845 A JP 8507183 T NO 943926 A NZ 259444 A SE 9300495 A US 5464258 A US 5533027 A	14/09/94 17/08/94 13/09/95 01/02/95 12/04/95 14/10/94 30/07/96 17/10/94 24/06/97 17/08/94 07/11/95 02/07/96

